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Hofstadter's Butterfly in the strongly interacting regime

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In 1976, Douglas Hofstadter predicted that in the presence of both a strong magnetic field, and a spatially varying periodic potential, Bloch electrons confined to a 2D quantum well exhibit a self-similar fractal energy spectrum known as the "Hofstadter's Butterfly." In subsequent years, experimental discovery of the quantum Hall effect gave birth to an expansive field of research into 2D electronic systems in the presence of a magnetic field, however, direct confirmation of the fractal spectrum remained elusive. Recently we demonstrated that graphene, in which Bloch electrons can be described by Dirac fermions, provides a new opportunity to investigate this nearly 40 year old problem. In this talk I will discuss the experimental realization of Hofstader's butterfly by exploiting nano-scale interfacial effects between graphene and hexagonal boron nitride substrates, together with application of extremely high magnetic fields. Utilizing newly developed techniques to fabricate ultra-clean graphene devices, I will additionally demonstrate the capability to probe for the first time the effect of strong electron interactions within the fractal Hofstadter spectrum.